Stochastic Newton MCMC for an inverse ice sheet model problem

Goal

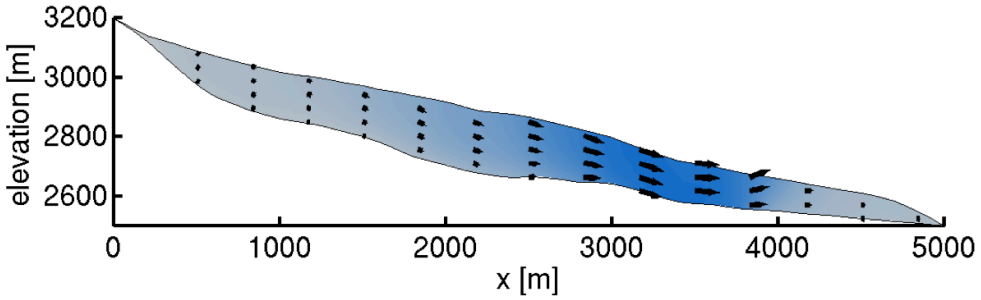
Development of methods for the full characterization of the uncertainty in the optimized basal sliding coefficient of an ice sheet

Approach

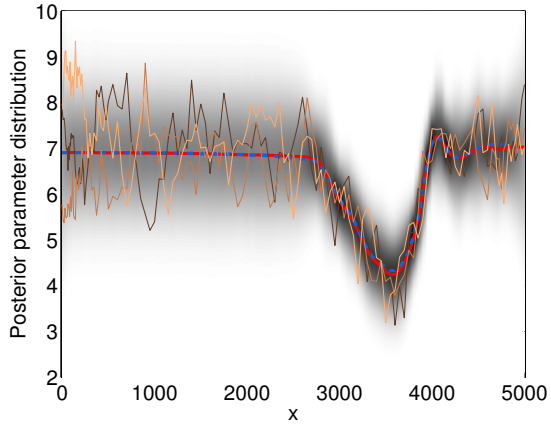
Use Markov chain Monte Carlo (MCMC) sampling with a proposal that uses local information of the probability distribution

- allows to explore high-dimensional probability distributions since it only focuses on the important directions
- Local approximations are computed using first- and second order derivative information of the log likelihood, computed through adjoint equations

Below: Longitudinal profile of Haut Glacier d'Arolla. Arrows indicate the flow speed computed from an optimized basal sliding coefficient. A lower coefficient leads to faster flow (blue regions).



Right: Reconstructed basal sliding coefficient: mean (red), maximum a posteriori estimate (blue) and discrete samples (shades of brown). The gray scale shows point marginal distributions with darker shading corresponding to higher probability density.



Impact

Demonstration of new approach for sampling high-dimensional parameter distributions, with future applications towards uncertainty quantification in large-scale ice sheet modeling

Petra, N. , J. Martin, G. Stadler and **O. Ghattas** (2014): A computational framework for inf.-dim. Bayesian inverse problems. Part II: Stochastic Newton MCMC with application to ice sheet flow inverse problem. *SIAM J. Sci. Comp. 36(4), pp. 1525-1555.*